edge of the coupling member 29 is cut away at four places as indicated at 57 in Figures 2 and 3. Each spring 54 has a tab 58 by which it may be inserted into or removed from position. Because of the flexibility of the springs, the cut-away portion 57 may be of small circumferential extent.

The connection between coupling member 29 and ring 31 may be identical except for dimensions to that just described and, therefore, will not be described in detail. It comprises a splined connection 59 between the parts and wavy springs 61 providing a bias toward a normal location of the parts but readily yieldable.

For the present, we may assume the ring 31 to be fixed. It will be apparent, therefore, that the five centers of the planet pinions define reference points of location. The sun gear and ring gear are meshed with the planet gears and are located by them. The sun gear may move radially and the ring gear may move radially or swing under the load to provide uniform tooth contact across the face of the teeth. The planet gears also swing if required in any direction. Under the heavy loads carried by a gear of this type, all of the parts will twist to some extent and the invention not only makes the gearing self-centering but compensates for the twist of the planet carrier.

The reduction gear also includes a structure by which negative torque is sensed. By negative torque is meant torque opposite in direction to that when the engine drives the propeller; which may result, for example, if the engine fails and the propeller windmills and drives it through the reduction gear. This structure employs a mounting of the ring gear on helical splines. Referring to Figure 1, the mounting ring 31 for the ring gear is externally helically splined at 63 and is mounted on internal helical splines 64 of a support ring 66 fixed to the reduction gear case by cap screws 67. A stop ring 68 limits rearward movement of ring 31, and its normal position is that shown, in engagement with the stop ring. Ring 31 is biased rearwardly by a number of coil springs 71 mounted in bores 72 in the nose of the case. Each spring acts against a cup 73 slidable in the bore 72 which has a projecting stud engaging the face of the ring 31. One or more of the cups 73 have fixed thereto plungers 74 extending slidably through the nose of the case.

The normal direction of torque biases the ring gear 28, member 29, and ring 31 in the direction to urge the ring 31 rearwardly on the splines. If the torque reverses, the reaction on the ring gear rotates the ring gear slightly, moving the ring 31 forwardly on the splines. The ring gear moves with it, but this is immaterial. As the ring 31 moves forwardly it compresses the springs 71 and projects the plunger 74. The springs are of sufficient strength to hold the ring 31 in its normal position until the negative torque exceeds a predetermined value above that encountered in normal operation of the power plant. The plungers 74 may be coupled by suitable mechanism (not shown) to the propeller to cause it to feather when the negative torque is abnormal.

The propeller shaft bearings 12 and 13 are retained on the shaft by a nut 76 locked against rotation by ring 77 splined both to the propeller shaft and the nut 76. The outer races of the bearings are received in a sleeve 78 retained by plate 79 which also forms part of and supports a gear pump 81 which supplies oil to the reduction gear. The structure of the oil pump is immaterial and will not be described in detail. It comprises gears 82 and 83, the latter of which is driven from the propeller shaft through gears 84 and 86. Plate 79 is retained by bolts 87 and 88, the latter of which also retain a collar 89 which retains an oil seal 91 for the bearings 12 and 13. The details of the seal are not illustrated.

Lubrication of the gears 26, 27, and 28 is effected by oil supplied by the pump 81 through passages not shown to a tube 92 extending through the shaft 24 to an oil distributor disk 93 mounted on the planet carrier spider 14. A small opening 84 in the tube releases oil to the inside of shaft 24 which flows along the inside of the shaft to splines 33. Oil also flows through five radial passages 96 in disk 93 to tubes 97 mounted in the disk which have a number of small orifices 98 through which oil is sprayed onto the sun gear and planet gears. This oil also is carried or flung onto the ring gear.

Five radiating passages 101 in the disk 93 connect to oil jet passages 102 in the forward spider 14 from each of which a jet of oil is discharged into the interior of a hollow pinion shaft 37. Annular oil barriers 104 are mounted in the ends of the shaft so that oil is trapped in the shaft and urged outwardly by rotation thereof. This oil flows through radial bores 105 to the roller bearings 44.

While the invention has been described in terms of a structure in which the ring gear is stationary, it will be apparent that it is immaterial to the invention which, if any, of the several elements, the sun gear, the planet carrier and the ring gear, is stationary. It will also be apparent that many modifications of structure from that disclosed as illustrative of the invention may be made by the exercise of skill in the art and that the detailed description of the preferred embodiment of the invention is not to be construed or limiting or restricting the invention.

We claim:

1. A planetary gear train comprising, in combination, a sun gear mounted with limited freedom for radial movement, a planet carrier mounted on a fixed axis coaxial with the sun gear and positively located axially of the axis, a number of planet gears rotatably mounted on the planet carrier and meshing with the sun gear, the centers of the planet gears being fixed relative to the planet carrier and the planet gears being universally mounted for swinging movement of the planet gear axes relative to the planet carrier, a ring gear meshing with the planet gears, and means mounting the ring gear with freedom for radial and swinging movement with respect to the said fixed axis.

2. A planetary gear train comprising, in combination, a sun gear mounted wtih limited freedom for radial movement, a planet carrier mounted on a fixed axis coaxial with the sun gear and positively located axially of the axis, a number of planet gears rotatably mounted on the planet carrier and meshing with the sun gear, the centers of the planet gears being fixed relative to the planet carrier and the planet gears being universally mounted for swinging movement of the planet gear axes relative to the planet carrier, a ring gear meshing with the planet gears, and means mounting the ring gear with freedom for radial and swinging movement with respect to the said fixed axis comprising a support and a coupling member connected by axially slidable splined connections to the support and the ring gear.

3. A planetary gear train comprising, in combination, a sun gear shaft, a sun gear mounted on the shaft with limited freedom for radial movement, a planet carrier mounted for rotation about a fixed axis coaxial with the sun gear shaft and positively located axially of the axis, a number of planet gears rotably mounted on the planet carrier and meshing with the sun gear, the centers of the planet gears being fixed relative to the planet carrier and the planet gears being universally mounted for swinging movement of the planet gear axis relative to the planet carrier, a ring gear meshing with the planet gears, and means non-rotatably mounting the ring gear with freedom for radial and swinging movement with respect to the said fixed axis.

4. A planetary gear train comprising, in combination, a sun gear mounted with limited freedom for radial movement, a planet carrier mounted on a fixed axis coaxial with the sun gear, a number of planet gears rotatably mounted on the planet carrier and meshing with the sun gear, the centers of the planet gears being fixed relative to the planet carrier and the planet gears being universal-